Validation of Autonomous Space Systems

Completed Technology Project (2012 - 2012)

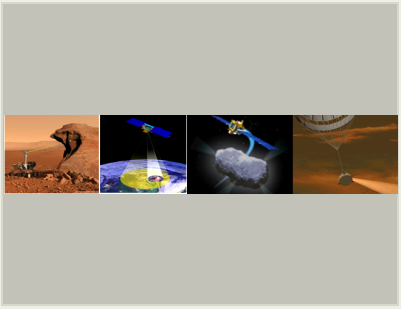
Project Introduction

System validation addresses the question "Will the system do the right thing?" When system capability includes autonomy, the question becomes more pointed. As NASA deploys systems deeper into remote environments where the operating conditions are at least partly unknown, the ability to predict details of the operating context – a motivation for pursuing autonomy – becomes more challenging. This workshop will explore system validation concepts for future NASA missions enabled by autonomy.

System validation addresses the question "Will the system do the right thing?" When system capability includes autonomy, or more specifically, onboard mission planning and possibly closed-loop control, the question becomes more pointed. As NASA deploys space systems deeper into remote environments where the operating conditions are at least partly unknown (planetary surfaces, vicinity of primitive bodies), the ability to predict the fine details of the operating context becomes more challenging, and by extension, also the ability to predict how the system will behave under those operating conditions. On the other hand, grappling with operational uncertainty is in fact a motivation for pursuing onboard autonomy. The workshop will explore system validation in the context of future NASA mission scenarios that are enabled by autonomy concepts. The workshop will address the following and related questions: • Are extant validation techniques and methodologies adequate or extensible to future mission scenarios and system autonomy concepts? • Is the concept of a system behavior envelope (an enforceable boundary on system behavior, independent of operating context) viable, both from an engineering safety and a mission success viewpoint? • Is it useful and perhaps necessary to view system validation as an activity that continues into operations (Phase E)? The workshop will generate the following products: • An evaluation of whether future autonomous systems validation can be addressed by extensions to existing validation approaches or requires new validation concepts • A set of prioritized research questions relating to autonomous systems validation, and addressable with a small investment • A set of potential technology investments coupled to the research questions

Anticipated Benefits

Our workshop can assist NASA missions currently in development or operations (e.g., MSL, OSIRIS-Rex) in addressing several questions relevant to the use and validation of autonomy.



Project Image Validation of Autonomous Space Systems

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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Jet Propulsion Laboratory (JPL)

Responsible Program:

Center Innovation Fund: JPL CIF

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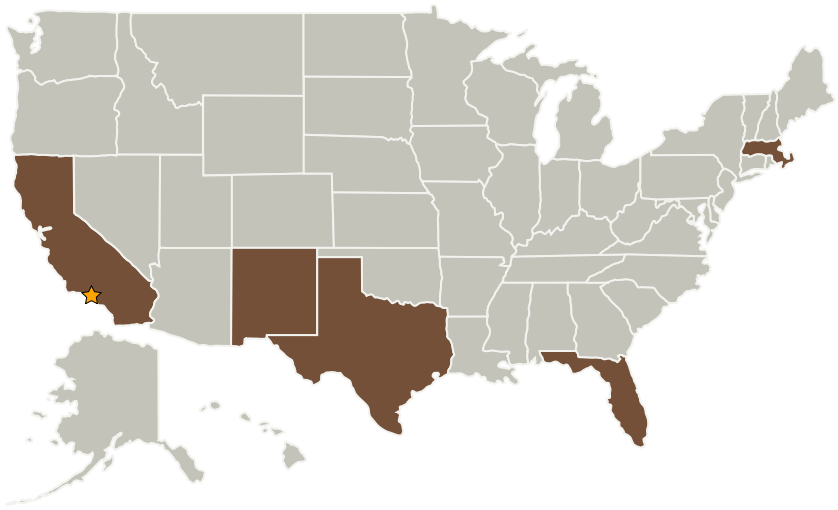
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Jet Propulsion Laboratory(JPL)	Lead Organization	NASA Center	Pasadena, California

Co-Funding Partners	Type	Location
Air Force Research Laboratory(AFRL)	US Government	Notre Dame, Indiana
Florida Institute for Human and Machine Cognition	Academia	Florida

Primary U.S. Work Locations	
California	Florida
Massachusetts	New Mexico
Texas	

Project Management

Program Director:
Michael R Lapointe

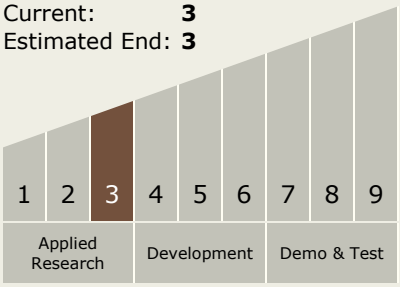
Program Manager:
Fred Y Hadaegh

Project Manager:
Jonas Zmuidzinas

Principal Investigator:
Richard J Doyle

Technology Maturity (TRL)

Start: **3**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX10 Autonomous Systems
  - TX10.2 Reasoning and Acting
    - TX10.2.2 Activity and Resource Planning and Scheduling

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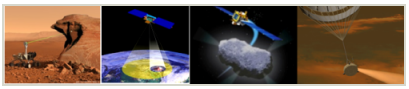
Images



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Project Image Validation of Autonomous Space Systems
(https://techport.nasa.gov/image/1178)